PROGRIS RIPORT 6.1

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000928

`itehu:~kotani/glast/txt/000928.kotani2.riport6`

1 Have Done

- Found no difference in the BGD-rejection performance between the 3-ROW ACD and the 4-ROW ACD, if their height is same.
- Found a great difference in the BGD-rejection performance between the 3-ROW ACD and the 4-ROW ACD, if the former is shorter than the latter.
- Investigated the nature of the BGD events remaining after my filter set.

1.1 The nature of remaining BGD events

The definition and the order of filters have been slightly changed since Riport 2 in accordance with Steve's filter set. The revised definition is shown in Table 1. Since the bottom line has not been changed, you don't have to worry about subtle differences from the old one, though i have to.

The remaining ratio of BGD events after this filter set is 7.0×10^{-5}. A typical BGD event surviving all filters is shown in Fig. 1. This event is made by

1. an albedo proton with an energy of sub GeV
2. entering the tower from below avoiding ACD tiles,
3. going through calorimeters,
4. making a track in a tracker, and
5. converted to γ rays in the tracker.

Such an event is expected to have a small Surplus_Hit_Ratio value and should be removed by a Surplus_Hit_Ratio cut. In this case, #2904 has a Surplus_Hit_Ratio of 2.375, a quite large value. It is under investigation why these events have a large Surplus_Hit_Ratio value.

On the other hand, there is a possibility that nothing is wrong with events or the codes but with the filter set. Applying the filter set to Toby's 10^7 BGD events is useful to constrain the problem. If my filter set is wrong, it is not effective to Toby's events. If my codes are wrong, my filter set works fine with Toby's events. So i tried to extract Toby's' events from the tape archive at SLAC only to find that my home directory in that site was unable to write for unknown reason at now. So it goes.

Table 1: Triggers and filters

Name	Code/Definition
L1T	bit4 | bit64 bit4: Any three x-y pairs in a row (TKR). bit64: LoCAL (1 log above threshold)
L2T	(bit1 & $\overline{\text{bit2}}$ & $\overline{\text{bit4}}$ & $\overline{\text{bit8}}$) | HiCAL bit1: A track candidate was found. bit2-8: A corresponding ACD tile was lit. HiCAL: 5 logs above threshold.
L3T†	No_Tracks > 0 && Veto_DOCA > 25
γ Exclusion†	Species $\neq \gamma$
New DOCA†	{(Veto_DOCA_S1 > 35 && Veto_DOCA_S2 > 35 && Veto_DOCA_S3 > 35) | CsI_Energy_Sum >20} && {No_Vetos_Hit < 1.5 || (CsI_Energy_Sum > 1. && No_Vetos_Hit < 2.5) || CsI_Energy_Sum > 50.}
Hit Pattern	Surplus_Hit_Ratio > 2.25 || (CsI_Energy_Sum >1 && fst_X_Lyr > 13) || CsI_Energy_Sum >5
CAL Info	{CsI_Xtal_Ratio>0.25 || CsI_No_Xtals < 1} && {(CsI_Energy_Sum < 1. && CsI_Fit_errNrm < 10.) || CsI_Fit_errNrm < 4. || CsI_No_Xtals <1}
Track Quality (Jose's filter)	Quality_Parm > 10. && {(CsI_Corr_Energy > 0 && t_angle < kalfit && |fit_kink| < kalfit) || (CsI_Corr_Energy $\leq$ 0 && t_angle $-\frac{3.5}{\text{\|gamma\_z\_dir\|}} < 0$ && |fit_kink| $-\frac{3.5}{\text{\|gamma\_z\_dir\|}} < 0$)} kalfit $= 3.5 \times 10^{-3} \times (\frac{3.0}{\text{Corr\_Energy} \cdot \text{\|gamma\_z\_dir\|}} + \frac{2.18}{\sqrt{\text{Corr\_Energy}} \cdot \text{\|gamma\_z\_dir\|}})$
S/C Ind. Ev. Cuts†0	&& {CsI_eLayer8/CsI_Energy_Sum<0.08 || CsI_eLayer1/CsI_Energy_Sum > 0.25 || CsI_Energy_Sum > 0.35 || CsI_No_Xtals < 1}
1	&& {CsI_moment1<15. || CsI_moment1<80. && CsI_Energy_Sum>0.35 || CsI_Energy_Sum>1. || CsI_No_Xtals<1}
2	&& {CsI_Z> -30. || CsI_No_Xtals<1}
3	&& {CsI_No_Xtals_Trunc<20. || CsI_Energy_Sum>75. || fst_X_Lyr<12}

†New or changed.

1.2 Comparison between 4 ROW and 3 ROW

I created two 3-ROW-ACD models by editing the instrument XML file of the 4-ROW-ACD model. One of them just lacks the last row on the sides, and the other has larger side tiles so that the total height of the side tiles equals to that of 4-ROW-ACD model. The instrument parameters are shown in Table 3.

The BGD rejection efficacy of these models are compared in Table 4. The 3-ROW model with the same height as the 4-ROW model achieved as good efficacy as the 4-ROW model, while the 3-ROW model without the 4th row shows more remaining BGD events by a factor of 2. Obviously, the rejection efficacy depends only on the height, not the number of tile, and it depends MUCH. This can be understood considering upon the nature of the remaining BGD events. As shown above, most remaining BGD events enter the tower from sides near the base. The 4th row is essential to remove these BGD events. If there is no 4th row, albedo protons are welcome. Therefore, the 4th row is very important to reduce the number of final BGD events.

Wait a second. We are now worried by too much remaining BGD events compared with Steve's or Jay's study. If the cause were found, the number of remaining BGD events might be reduced by an order. Is the 4th row important even with such a small number of remaining BGD events?

2 To Do

- See how effective my filter set is by applying it to Toby's 10^7 BGD events.
- Compare the γ-ray acceptance ratio between the 4ROW ACD and the 3ROW ACD.
- Investigate the Surplus_Hit_Ratio value of remaining BGD events.

Table 2: Filters and remaining events

	GSFCACD4ROW		Ritz (2000)
Generated	1	851253	1 (10^7)
L1T	2.2×10^{-1}	188261	—
L2T	9.3×10^{-2}	78993	—
L3T	7.7×10^{-3}	6525	2.5×10^{-3}
γ Exclusion	5.1×10^{-3}	4303	—
New DOCA	3.6×10^{-3}	3048	6.1×10^{-4}
Hit Pattern	5.3×10^{-4}	449	1.6×10^{-4}
CAL Info	2.3×10^{-4}	192	4.2×10^{-5}
Track Quality	1.2×10^{-4}	101	2.6×10^{-5}
S/C Induced Event Cuts 0	7.0×10^{-5}	50	
1	7.0×10^{-5}	50	
2	7.0×10^{-5}	50	
3	7.0×10^{-5}	50	4.0×10^{-6}

Table 3: Instrument parameters

Parameter	4 ROW	3 ROW (Same Height)	3 ROW (No 4th ROW)	Remark
num_side_tiles	4	3	3	Number of A/C side tiles (per side)
side_tile_heights	25, 20, 15, 15	31, 31, 13	25, 20, 15	height of side tiles (cm)
side_tile_NumInRow	5, 5, 10, 10	5, 5, 10	5, 5, 10	number of tiles per row from top to bottom

Table 4: 4ROW vs. 3ROW

	4 ROW		3 ROW (Same Height)		3 ROW (No 4th ROW)	
Generated	1	851253	1	2×10^6	1	10^6
L1T	2.2×10^{-1}	188261	2.2×10^{-1}	442265	2.2×10^{-1}	221229
L2T	9.3×10^{-2}	78993	6.1×10^{-2}	122379	8.2×10^{-2}	81566
L3T	7.7×10^{-3}	6525	7.6×10^{-3}	15199	8.8×10^{-3}	8815
γ Exclusion	5.1×10^{-3}	4303	5.0×10^{-3}	10050	6.3×10^{-3}	6270
New DOCA	3.6×10^{-3}	3048	3.6×10^{-3}	7143	4.9×10^{-3}	4858
Hit Pattern	5.3×10^{-4}	449	5.6×10^{-4}	1116	8.7×10^{-4}	871
CAL Info	2.3×10^{-4}	192	2.3×10^{-4}	458	3.3×10^{-4}	334
Track Quality	1.2×10^{-4}	101	1.3×10^{-4}	258	1.9×10^{-4}	190
S/C Induced Event Cuts 0	5.9×10^{-5}	50	8.3×10^{-5}	165	1.5×10^{-4}	147
1	5.9×10^{-5}	50	8.3×10^{-5}	165	1.5×10^{-4}	147
2	5.9×10^{-5}	50	8.2×10^{-5}	163	1.5×10^{-4}	146
3	5.9×10^{-5}	50	8.2×10^{-5}	163	1.5×10^{-4}	146

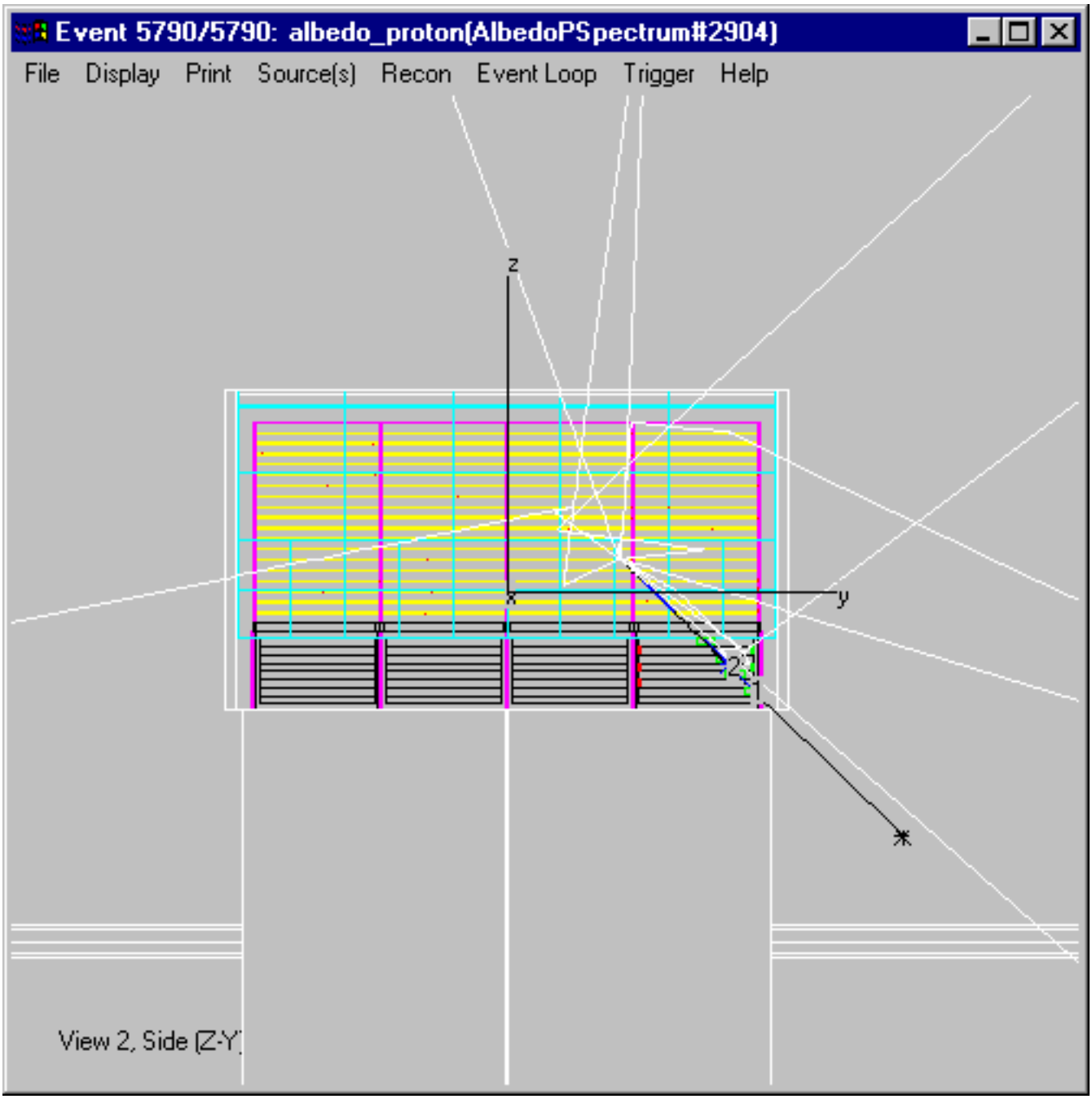

Figure 1: A remaining BGD event
An albedo proton comes from the lower right, penetrates the calorimeter, and vanishes in the tracker.

Note Added on 001024

The cause of the difference between the remaining BGD ratio of this work (7×10^{-5}; GSFCACD4ROW in Table 2) and that for the AO (4×10^{-6}; Ritz (2000) in Table 2) was identified at last. The "backgndmix" spectrum for this work contains albedo protons, while that for the AO does not. The albedo-proton component was added to source_library.xml on August 3, 1999, and the BGD events for the AO were generated with the version before that. Since current filter set shown in Table 1 is optimized for the backgndmix spectrum without the albedo-proton component, it is not effective to events like that in Fig. 1. A study to optimize it for albedo protons is necessary.